PATTERN OBSERVED IN ELECTROLYSIS

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Plate XI

ABSTRACT. Very dilute solutions of HCl, H_2SO_4, $CuSO_4$ and NaCl were electrolysed in a rectangular trough. Regular linear patterns were produced by the chemical action of chlorine and sulphate ions on the anode plate and by the deposit of sodium and copper ions on the cathode plate. Evolution of hydrogen ions in the form of linear vertical patterns was also noticed on the cathode plate. From the observations it is suggested that the motion of ions takes place in discrete layers under the action of electric field.

INTRODUCTION

While performing an experiment on electrolysis with a very dilute solution of $CuSO_4$, it was observed that chemical action took place over the anode in the form of linear vertical lines separated by distinct regions of no chemical action. The experiment was repeated with various dilute solutions and identical effect was noticed in all cases.

EXPERIMENTAL ARRANGEMENT

In figure 1, *DF* is a rectangular trough containing a vertical anode plate *B* and a vertical cathode plate *C*, each having an area of nearly 200 sq. cms. The concentration of the solute was roughly 1 grm. per litre. A current of 0.2 amp was passed for about 3 hours. On the anode side, the pattern was produced by the chemical action of chlorine or sulphate ions on the anode plate. The pattern came on all plates but the best contrast was produced when aluminium was used as anode. On the cathode side, the pattern was produced by the deposit of sodium or copper ions on the cathode plate. Evolution of hydrogen ions also produced the pattern on the cathode plate. The anode and the cathode plates were cut at random from one big sheet so that the orientation of the edges of the different plates were different with respect to the edges of the original big sheet.

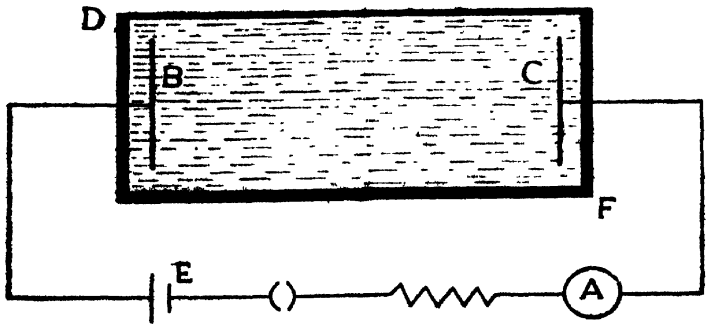

FIG. 1

EXPERIMENTAL RESULTS

The exprimental result is indicated in Plate XI. By illuminating the electrode plates from one side, the pattern can be demonstrated to a large audience while electrolysis is going on. About 70 exposures were given and each time a pattern was observed. The result is also reproduced when the solutes are changed. Attempts with HCl, H_2SO_4, NaCl and $CuSO_4$ solutions have been successful. On the cathode side brass and aluminium plates were used and the fringe system due to hydrogen ion was photographed. With the change of cathode plate, the hydrogen ion pattern is reproducible with almost identical spacings.

The spacing of the fringe system depends on the current and diminishes when the current is increased. The distance of separation between two consecutive lines of the pattern were measured with a comparator and the values were found to lie between 0.24 mm. and 0.74 mm.

DISCUSSION

The observation recorded in the paper does not appear to have been noticed by previous experimenters. This may be due to the fact that for the successful production of the pattern reported by the author. it is very much necessary to use very dilute solution, to keep the current density low, and to pass the current for a long interval of time. With comparatively strong solutions or larger current densities, the spacings between successive lines get reduced and escape observation.

In all the observations, vertical linear patterns are simultaneously produced on the cathode and anode plates. The distances of separation between the lines on both the plates are of the same order. With the change of plate on the cathode side, the hydrogen ion lines are produced with almost identical spacings. If this phenomenon were due to surface action, the patterns observed could not have been vertical on all the plates. In some plates these would have been obviously oblique, because the edges of these plates were inclined to the edges of the original sheet. So the possibility of the phenomenon being produced by surface conditions of the electrodes is ruled out. It is suggested that under the action of the electric field the solutes arrange themselves in discrete layers inside the solution. Further experiment is being done to study the actual nature of the phenomenon.

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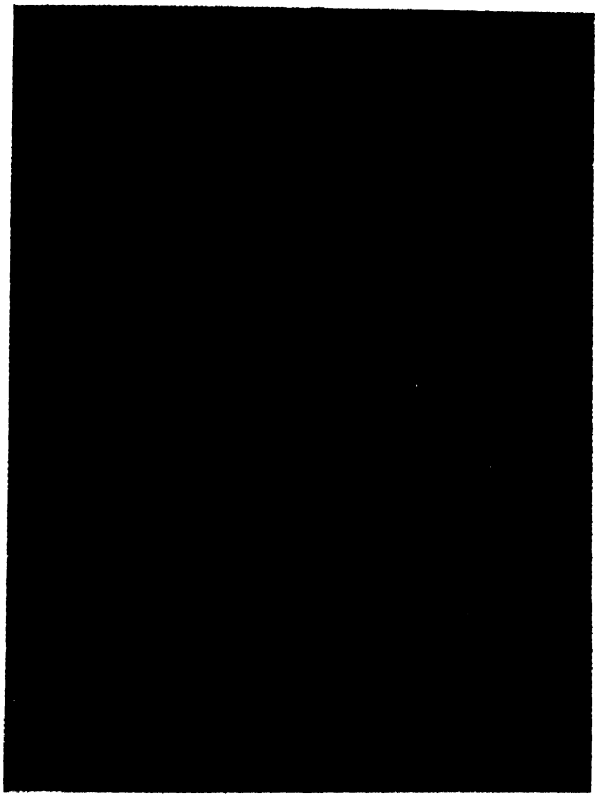

Fig 2

Pattern observed on the aluminium anode plate.